Groundwater Section

Guidelines for Disinfecting Dug and Drilled Wells

Groundwater, by nature, is bacterially pure. The presence of total and faecal coliform in well water is evidence that pollution has occurred in the well. These contaminants cannot be detected by taste or visual inspection, making them a hidden hazard.

Bacterial contaminants are common to the hands, tools and materials used in well construction and maintenance, requiring disinfection immediately after a well is worked on. A coliform contamination problem that persists after disinfection is indicative of poor well construction, degrading construction materials, or nearby land/water use activities.

Testing

From a well owners point of view, a bacteriological analysis is the most important water test to be done on drinking water. Well water may have a poor taste because of high concentrations of some parameters, such as iron and manganese, however, the physical and chemical aspects of groundwater quality rarely result in well water being unsafe for drinking.

Testing for bacterial contamination in a well and water supply system is recommended as follows:

- ten days after the well and water supply system has been disinfected;
- when there is a noticeable change in colour, odour, or taste of the well water;
- when flooding has occurred near the well;
- when any family member or animal becomes sick from a suspected waterborne disease; and
- within twelve months after the previous bacteriological analysis.

Purpose of Disinfecting a Well

The purpose of disinfecting a dug or drilled well is to destroy all disease causing microorganisms (pathogens) that may have been introduced into the well during construction, hookup, maintenance, or as a result of faulty well construction.

Disinfection is also recommended for well systems that experience problems with iron bacteria or sulphate-reducing bacteria. Iron bacteria create deposits of stringy, rusty coloured jelly-like slime on the inside of the well, pumping system, and in the water filled pore spaces in the ground. Sulphate-reducing bacteria feed off sulphate to produce hydrogen sulphide gas (characterized by a "rotten egg" odour) and scale deposits. Both problems can severely reduce well yield and the efficiency of the water supply system.

Recommended Disinfectant

Chlorine compounds are the most popular disinfectant for drinking water because of their potency and effectiveness on a wide range of germs. Chlorine is also easy to use, relatively inexpensive, and persists in a well long enough to kill harmful organisms.

Of the chlorine compounds, calcium hypochlorite is the preferred source of chlorine used to disinfect wells. Calcium hypochlorite remains fairly stable when dry retaining 90% of its chlorine content after a one year storage period. It can be purchased in granular and tablet form containing

65-70% available chlorine by weight. This means for every 1 kg of calcium hypochlorite, 0.65 to 0.70 kg (650 to 700 grams) of chlorine is available for disinfection. Care must be taken when handling calcium hypochlorite because deadly chlorine gas can be released when the substance is wet.

Sodium hypochlorite may be used in the absence of calcium hypochlorite. This chemical is available only in liquid form in strengths up to 12-15% available chlorine. This means for every 1 litre used, 0.12 to 0.15 litres of chlorine is available for disinfection, the rest is water. The unstable nature of sodium hypochlorite solutions may result in the labeled chlorine concentration not being available for disinfection at the time of use. A common form of sodium hypochlorite is household laundry bleach that has, at best, approximately 5% available chlorine.

Storage of any chlorine compound is difficult, therefore, it is best to have on hand only the amount needed at any one time. Dry chlorine compounds should not be stored for more than one year. Liquid chlorine compounds should not be stored for more than 60 days. Compounds should not be exposed to the atmosphere or direct sunlight during storage. It must be remembered that storage under some conditions can be dangerous. Contact can damage eyes and skin, therefore, care must be taken when handling all the chlorine compounds.

Shock Chlorination

Shock chlorination refers to the placement of a strong chlorine solution in a well and/or water supply and distribution system to kill nuisance and disease causing organisms. Shock chlorination of a dug or drilled well and water supply system is recommended immediately after:

- the construction of a well;
- the installation of a pump and fittings;
- the well or water supply system has been opened for expansion or repair;
- the well water has tested positive for bacteriological contamination; and
- to keep in check problems with iron bacteria and sulphate-reducing bacteria.

Note: Shock chlorination may not completely eliminate iron bacteria or sulphate-reducing bacteria from a well and water supply system, but should hold it in check. Shock chlorination may have to be repeated periodically in order to control these problems.

Recommended Concentration of Chlorine

To properly disinfect a well and water supply system, the minimum concentration of chlorine in the well should be 100 to 300 parts per million (ppm), depending on the need for disinfection. For minor repairs outside the well, a minimum chlorine concentration of 100 ppm is recommended. To disinfect a newly constructed well, a well contaminated with coliform bacteria, or following repairs to a well or water supply system, a minimum chlorine concentration of 200 ppm is recommended. For nuisance problems, such as iron bacteria and sulphate reducing bacteria, a minimum chlorine concentration of 300 ppm is recommended. Over chlorination of a well typically does not present a problem. Therefore, it is better to add an excessive amount of chlorine solution rather than not add enough.

The Disinfection Procedure

The following procedure is recommended for thorough disinfection of a dug or drilled well and water supply system.

- Clean the well. All oil, grease, scum and other material which can harbour and protect bacteria from disinfectants should be thoroughly cleaned from the well. Scrub all accessible interior surfaces (including the well cap) using a strong chlorine solution and alkalis if

required. Pump to waste through an outside hose until water is clear of all suspended matter.

- Determine the amount of chlorine source required per foot of well depth to give the recommended chlorine concentration in the well. Refer to the following table.

Amount of Chlorine Source to be used Per Foot of Well Depth (source - calcium hypochlorite or sodium hypochlorite)												
	Chlorine Concentration											
Well	100 ppm % Chlorine Available in Source				200 ppm % Chlorine Available in Source				300 ppm % Chlorine Available in Source			
Diameter	3%	5%	12%	65%	3%	5%	12%	65%	3%	5%	12%	65%
inches	litres	litres	litres	kilograms	litres	litres	litres	kilograms	litres	litres	litres	kilograms
4	0.008	0.005	0.002	0.0004	0.017	0.010	0.004	0.0008	0.025	0.015	0.006	0.0011
6	0.019	0.011	0.005	0.0009	0.037	0.022	0.009	0.0017	0.056	0.033	0.014	0.0026
8	0.033	0.020	0.008	0.0015	0.066	0.040	0.017	0.0030	0.099	0.059	0.025	0.0046
10	0.052	0.031	0.013	0.0024	0.103	0.062	0.026	0.0047	0.154	0.093	0.039	0.0071
12	0.074	0.045	0.019	0.0034	0.148	0.089	0.037	0.0068	0.223	0.134	0.056	0.0103
18	0.167	0.100	0.042	0.0077	0.334	0.200	0.083	0.0154	0.501	0.300	0.125	0.0231
24	0.297	0.178	0.074	0.0137	0.593	0.356	0.148	0.0273	0.890	0.534	0.222	0.0410
36	0.667	0.400	0.167	0.0307	1.334	0.801	0.334	0.0615	2.001	1.201	0.500	0.0922
48	1.186	0.712	0.297	0.0546	2.372	1.423	0.593	0.1093	3.558	2.135	0.890	0.1639
60	1.853	1.112	0.463	0.0854	3.706	2.224	0.927	0.1707	5.559	3.335	1.390	0.2561
84	3.632	2.179	0.908	0.1673	7.264	4.358	1.816	0.3346	10.895	6.537	2.724	0.5019
108	6.004	3.602	1.501	0.2766	12.008	7.205	3.002	0.5531	18.011	10.807	4.503	0.8297

Examples:

To chlorinate a newly drilled well 6 inches in diameter and 220 feet deep. Using the minimum recommended chlorine concentration of 200 ppm for a newly constructed well, and selecting to use calcium hypochlorite (65% available chlorine) as the source of chlorine, the amount of source to be used is calculated as follows:

220 feet x 0.0017 kilograms per foot = 0.374 kilograms = 374 grams

To chlorinate a dug well because of coliform bacteria contamination. The well is 60 inches in diameter and 14 feet deep with a water depth of 4 feet. Using the minimum recommended chlorine concentration of 200 ppm for a well contaminated by coliform bacteria, and selecting to use sodium hypochlorite at 5% available chlorine (laundry bleach) as the source of chlorine, the amount of source to be used is:

4 feet x 2.224 litres per foot = 8.9 litres

Note: For chlorinating drilled wells, normally the well depth to the water line is negligible and therefore does not require consideration.

- Prepare the stock solution by mixing the recommended amount of chlorine source with a few gallons of water in a clean plastic bucket. Stock solutions should be prepared to meet immediate needs only, liquid solutions lose strength rapidly unless properly stored.
- Introduce the stock solution into the well taking care to wash the inside of the casing above the water line.
- Mix the water column in the well thoroughly by pumping to recirculate the chlorinated water back into the well through a hose attached to a faucet or outside outlet.
- The returning water must have a strong chlorine odour. If not, add more chlorine solution to the well.

Caution: A rubber air-water separator in the pressure tank may be damaged by too strong a chlorine solution.

- Wash down the well casing and drop pipe as the water is returned to the well through the hose.
- Open each faucet in the distribution system one at a time letting the water run until it has a strong chlorine odour (include all appliances that use water such as a washing machine, flush box, dishwasher, etc.).
- Drain all water system accessories, such as water heaters and hot water tank, and allow them to refill with chlorinated water. Release the air from the pressure tank (except tanks with a permanent air cushion) to completely fill the tank with chlorinated water. Backwash the water softener and all filters (except carbon filters) with chlorinated water.

Caution: Before disinfecting the distribution system, temporarily remove or bypass any carbon filter in the system.

- Allow the chlorinated water to rest in the well and the complete water supply system for at least 12 hours (preferably overnight) but not more than 24 hours.
- After the 12 hour minimum standing period, the well water should be allowed to flow to waste. First, through an outside hose until no further chlorine odour is detected, then through each faucet or outlet within the home until they, too, indicate no further chlorine odour.

Caution: Chlorinated water should NEVER be allowed to drain into the septic system.

- When no chlorine odour is detected, continue pumping the well to waste long enough to change the volume of water in the well several times.
- Lastly, to make sure the water supply system has been thoroughly disinfected, sample the well water at the kitchen faucet ten days after the well was disinfected and test for the presence of coliform bacteria.

Flowing Artesian Wells

Flowing artesian wells (wells that are naturally overflowing at the surface) are disinfected by lowering a perforated container filled with an adequate quantity of dry calcium hypochlorite to the bottom of the well. The perforated container can be constructed from a short length of tubing capped at both ends. The natural upflow of water in the well will distribute the dissolved chlorine throughout the full depth of the well. The flow at the top of the well can be partially or completely restricted to reduce the loss of chlorine. The water supply system can be disinfected in the manner previously outlined.

Follow Up

After the well has been thoroughly pumped to flush the system of chlorine, use the water supply (except for drinking) for approximately 10 days. Then sample for the presence of coliform bacteria. Do not rely on one sample. Two or three consecutive safe tests are needed to guarantee there is no coliform bacteria present in the well and water supply system. Samples should be collected by pumping the well water to waste for a minimum of 15 minutes and duplicate bacteriological samples collected not less than 30 minutes apart.

The well may be used as a drinking water supply only if none of the samples collected indicate the presence of coliform bacteria. The well water should be retested if any samples do indicate coliform bacteria. If this fails, subject the well to corrective action determined by a qualified professional.

It is recommended that the Government Services Centre collect water samples for coliform bacteria testing. If the owner must do so, use only the special sterile bottle and the instructions provided by the Department of Health and Community Services.

Safeguards to Avoid Well Contamination

The following safeguards are helpful in preventing contamination problems in a well due to bacteria and other pollutants. A well owner should make an inspection of his or her well and take the necessary steps to ensure these safeguards are met.

- Finish the wellhead not less than 0.5 metres above ground level, or 0.3 metres above a pump house floor. In no case should the well head be buried.

- Seal the upper open end of the well casing in an approved manner. In an outside environment, the well must be capped with an approved vermin proof well cap; i.e. one that securely attaches to the well head to prevent tampering with the well, and has a screened vent to provide ventilation and prevent the entry of foreign materials including vermin into the well. In an inside environment (e.g. pump house), a sanitary well seal may be used instead of the vermin proof well cap. However, a shielded screened vent must be integrated into the application of the sanitary well seal.

Note: Failure to provide adequate ventilation to a drilled well will likely result in damage to the formation seal due to a vacuum created inside the well during 'drawdown' of the water level. A damaged formation seal will permit surface water and/or shallow groundwater to enter a well carrying pollutants into the water supply.

- Use a pitless adaptor in the hookup of water supply lines to a drilled well. The pitless adaptor is designed to provide a water tight sanitary seal where the water supply line(s) passes through casing wall. The pitless adaptor readily disconnects to allow easy removal of the pump and/or supply line(s). In an inside environment (e.g. pump house), a sanitary well seal may be used instead of the pitless adaptor.

- Make all connections to the well water tight. Where a connection to the well casing is made for reasons of water supply hookup, electrical ground, or other purposes, the connection must be water tight regardless of whether the connection is made above or below the ground surface.

- Properly backfill the annular space around the well casing. Surface water may seep down around the well casing and into the well carrying pollutants.

- Slope the area around the well head for a distance of at least 5 metres to divert surface water away from the well. Ponding of surface water can permit pollutants to be carried down around the well casing and into the well.

- Do not use fertilizers around or near the well head.

- Do not use wood in or around the well. Wood used in the construction of a dug well, or in a non vented shelter for a drilled well, can harbour insects, harmful bacteria, virus and other microbes creating contaminant problems in the well.

- Install anti-backflow devices on all faucets and outlets with hose connections.

- Permanently seal or properly cap and protect all unused or abandoned wells on the property. The Department of Environment has strict guidelines that must be followed to properly and legally seal an abandoned well.

- Routinely check well water for bacteriological contamination at least every 12 months to ensure the water supply is safe. Groundwater is naturally bacteria free, therefore, the presence of bacteria may indicate a problem with well construction or hookup.

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